

**Geologic and Seismic Hazards Assessment  
New Fire Station No. 21  
NEC of International & Maple Avenues  
Fresno, California**

**BSK 01-21-0051**

*Prepared for*

**City of Fresno Public Works Department  
2600 Fresno Street, 4<sup>th</sup> Floor  
Fresno, CA 93721**

**December 9, 2002**

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**BSK 01-21-0051**

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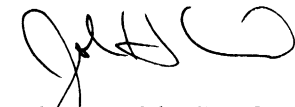
**SUBJECT: Geologic and Seismic Hazards Assessment  
New Fire Station No. 21  
NEC of International & Maple Avenues  
Fresno, California**

Dear Mr. Kishi:

The enclosed geologic and seismic hazards assessment for the subject site has been prepared by BSK Associates (BSK) on behalf of City of Fresno Department of Public Works (Owner, Client). The assessment was conducted in accordance with BSK's Proposal 01-21-0051, dated October 15, 2002.

BSK appreciates the opportunity to be of service to the City of Fresno. Please contact us if you have questions or need additional information.

Respectfully submitted,  
**BSK ASSOCIATES**



John H. Kirk, C.E.G.  
Senior Engineering Geologist



JHK/jam

Enclosure

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BSK Project File (1 original, 1 copy)

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**GEOLOGIC AND SEISMIC HAZARDS ASSESSMENT  
NEW FIRE STATION NO. 21  
NEC OF INTERNATIONAL & MAPLE AVENUES  
FRESNO, CALIFORNIA**

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**EXECUTIVE SUMMARY**

This report presents the results of BSK Associates' geologic and seismic hazard assessment for the planned new Fire Station No. 21 in Fresno County, California.

Numerous active and potentially active faults are present within the 100-mile search radius of the Site and considered capable of causing low to moderate ground motion. The greatest occurrence of earthquakes has been and likely will continue to be associated with the active San Andreas Fault System located 122 kilometers southwest of the Site, as well as with seismic activity occurring in the Coast Ranges.

No faults have been mapped crossing the Site and the potential for ground rupture is low. The property does not lie within a Fault-Rupture Hazard Zone as identified under the Alquist-Priolo Geologic Hazards Zone Act.

The estimated peak horizontal acceleration at the Site due to earthquake ground motion is 0.17g for the Design Basis Earthquake and 0.19g for the Upper Bounds Earthquake. The Design Basis Earthquake is used for essential services buildings and is the Maximum Probable Earthquake as defined by the 2001 California Building Code (10% probability of exceedance in 50 years). The Upper Bounds Earthquake is the ground motion more typically used in hospital design and is defined by the California Building Code as the ground motion having a 10% probability of exceedance in 100 years. The minimum ground acceleration value used by the California Division of Mines and Geology for Central Valley sites is 0.20 g.

BSK's liquefaction analysis indicates that conditions conducive to liquefaction are not present. The Site does not lie within the limits of the 100-year flood. The Site does not lie within the limits of inundation in the event of a catastrophic failure of Friant dam. Based on Site location and topographic characteristics, slope failure, ground lurching and volcanic eruption would not likely impact the Site.

**GEOLOGIC AND SEISMIC HAZARD ASSESSMENT  
NEW FIRE STATION NO. 21  
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FRESNO, CALIFORNIA**

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## **1.0 INTRODUCTION**

This report presents the geologic and seismic hazards assessment prepared in accordance with Title 24, Chapter 16 requirements for an Engineering Geologic Report. The assessment has been prepared for a new Fire Station site in Fresno County, California (the “Site”).

### **1.1 Objective and Scope of Services**

The objective of the geologic and seismic hazards assessment is to provide the Client with an evaluation of potential geologic or seismic hazards which may be present at the site or due to regional influences. BSK’s scops of services for this assessment included the following: a review of published geologic literature; an evaluation of the data collected; Deterministic Seismic Hazards Assessment (DSHA); Probabilistic Seismic Hazards Assessment (PSHA); liquefaction and seismic settlement analyses; and exploratory borings and laboratory physical testing of soil samples.

### **1.2 Site Location and Description**

The planned new Fire Station is located north of International Avenue and east of Maple Avenue in Fresno County, California. The site is located in the northwest one-quarter of section 13, township 12 south, range 20 east, Mount Diablo baseline and meridian (see Figure 1, Vicinity Map).

At the time of BSK’s field exploration, the proposed project site was vacant and unpaved. A pump station occupies the north end; some soil material stockpile and removed asphalt concrete chunks were present. A power pole with lines are at the southwest corner. The site was an formerly an orchard farm; International Avenue is at its south and North Maple Avenue is at its west.

### **1.3 Latitude and Longitude**

The site is centered at latitude N36.8891 and longitude W119.7467, as shown on the “Friant, California” USGS 7.5 minute topographic quadrangle map (dated 1964, see Figure 2).

### **1.4 Project Description**

BSK’s understanding of the planned construction was based on information provided by Mr. Kishi, which included faxed copy of the site drawing. The planned construction will consist of a single-story masonry and steel framed structure with slab-on-grade. Project site may require several feet of cut/fill to develop building pad and parking grades. The fire station will be about 13,200 square feet in size. Entrance drives for the fire trucks will consists of portland cement concrete paving and automobile parking areas will consist of asphalt concrete. Masonry screen walls will be installed around the existing water pump station with an anticipated height of 8 feet.

## **2.0 PHYSIOGRAPHY AND GROUNDWATER CONDITIONS**

The following sections describe the physiography and groundwater conditions regionally and for the school site. Soil descriptions are provided in the main body of this report and test hole logs are presented in Appendix A.

### **2.1 Site Physiography**

Site topography is essentially flat, with an average ground surface elevation of approximately 390 feet, USGS datum.

### **2.2 Soil Conditions**

BSK performed a field investigation which consisted of performing a site reconnaissance and subsurface exploration. Test hole borings were drilled during our field investigation, conducted in November, 2002, using a truck-mounted drill rig equipped with an 8-inch diameter hollow-stem auger. Maximum explored boring depth was 50.5 feet. The test borings were drilled at the approximate locations shown on the Site Plan in the companion geotechnical engineering report. Standard Penetration Tests were performed in accordance with ASTM D1586 test procedures. The number of blows required to drive the last 12 inches was recorded as Penetration Resistance (blows/foot) on the logs of borings. The test boring was logged by a BSK engineer (See Appendix A for test boring log of the deep boring). Subsurface soils encountered in the borings consisted primarily of medium dense to dense silty sands up to depths of about 8 to 15 feet bgs, which were underlain by medium dense to dense to very dense, fine to medium grained sands with gravel. "Hardpan" soils were encountered in some of the borings at depths as shallow as 2 feet. The boring logs in Appendix A provide a more detailed description of the soils encountered, including the applicable Unified Soil Classification System symbol.

### **2.3 Groundwater Conditions**

The Site is within the San Joaquin Basin Hydrologic Study Area. This includes approximately the southern two-thirds of the Great Valley. Within the Study Area, 39 groundwater basins and areas of potential storage have been identified. The boundaries of these areas are based largely on hydrologic as well as political considerations. General movement of groundwater within the San Joaquin Valley is from the flanks of the valley to the axis of the trough on the western side of the valley and, subsequently, northerly toward the Sacramento-San Joaquin Delta area (Page, 1986).

Groundwater was not encountered during the course of our field investigation. To ascertain groundwater levels for use in the liquefaction analyses, groundwater elevations from California Department of Water Resources (DWR) water level monitoring records were reviewed. Records were available for the period 1953 to 2002. During this period, water surface elevations were generally level until about 1975 then began a descent to a depth of approximately 140 feet.

### **3.0 SEISMIC HAZARD ASSESSMENT**

The State Fault Map of California (Jennings, 1994) shows faults in the region, including the major strike-slip faults associated with the San Andreas Fault System. Each of the active faults shown on the fault map (see Figure 6 for the Regional Fault Map) has been incorporated in our Probabilistic Seismic Hazard Analysis presented in following sections of this report.

#### **3.1 Geologic Setting**

The site is located in the east-central portion of the San Joaquin Valley, a broad topographic and structural trough in Central California. The Valley is bordered on the east by the Sierra Nevada and on the west by the Coast Ranges. The structural floor of the Valley is asymmetrical, sloping westward to its greatest depth near the western margin of the Valley. The valley fill consists of a sequence of marine and overlying continental sediments, Jurassic to Holocene in age, that reach a thickness of as much as 28,000 feet on the southwest side of the Valley (Page, 1986). Figure 3, Regional Geologic Map, shows the distribution of geologic units in the site region. Figure 4, Geologic Cross-Section, indicates subsurface geologic conditions perpendicular to the long axis of the valley trough.

The site is situated on Recent age alluvial fan sediments of the San Joaquin, derived from the Sierra Nevada to the east. These sediments are classified as Younger Alluvium.

#### **3.2 Faults**

The Seismic Hazards Analysis uses a data base of faults with associated parameters. The database includes the most current fault parameter information from the California Division of Mines and Geology, found on their Internet web site.

For this analysis, a search radius of 100 miles was used. Distances to the faults are shown on Table 2 (a summary of a database search for earthquakes within 100 miles of the site). Faults with the greatest potential to produce strong ground motion at the site are described below.

##### ***Basin and Range - Sierra Nevada Faults***

Active and potentially active faults on the east side of the Sierra Nevada (associated with continuing mountain building of the Sierra) include the Owens Valley Fault, the Sierra Nevada Fault Zone, the White Mountains Fault Zone and a number of smaller faults with tectonically related activity, including the Independence, Hartley Springs, Hilton Creek, Panamint Valley, Deep Springs, Round Valley, Robinson Creek and faults and earthquake activity associated with potential volcanism in the Long Valley Caldera, the Mono Craters Caldera and Inyo Craters. The Owens Valley Fault was responsible for generating the 8+ magnitude earthquake occurring in 1872.

*Owens Valley Fault length: 121 km*

*Fault slip rate: 1.5 mm/year*

*Earthquake return interval: 4,000 years*

### ***Great Valley Fault System***

The Great Valley Fault System is a topic of ongoing research which primarily commenced with the Coalinga Earthquake of 1983, attributed to the system. Fault plane solutions for the Coalinga Earthquake sequence suggest a northwest strike with either a steep northeast dip or shallow northwest dip (Eaton et al., 1983). Eaton (1985b) proposed that the main Coalinga earthquake, as well as the 1985 North Kettleman Hills earthquake (1985a), occurred on a shallow westward dipping thrust fault and slip was induced on northeast and southwest dipping reverse faults in the plate overlying the thrust fault. Namson and Davis (1988) interpret an approximately 200 km long zone of folds (anticlines and synclines) along the southwestern margin of the San Joaquin Valley as an actively developing fold and thrust belt. Namson and Davis (1988) attribute the seismically active Coalinga and Kettleman Hills North Dome anticlines to fault-bend folding above a thrust fault, which does not reach the surface (blind thrust).

Wong et al. (1988) indicated that geologic evidence suggests that the boundary is not a single fault but a complex zone of faulting with the potential of generating large earthquakes (such as the Richter Magnitude 6.7 Coalinga earthquake) over most of its length.

*Great Valley Fault Segment 14 length: 24 km*

*Fault slip rate: 1.5 mm/year*

*Earthquake return interval: 414 years*

### ***San Andreas Fault Zone***

The San Andreas Fault System is one of California's most prominent structural features, with a length of approximately 1,000 miles extending from Cape Mendocino to the Salton Sea. The System has been divided into segments by several authors (e.g., Wallace, 1970; Sieh and Jahns, 1984) based on tectonic behavior, trace configuration and long-term slip rates. Three partially overlapping segments presented by Wesnouski (1986) pose earthquake hazards to the site. These segments extend southeastward from Slack Canyon, which represents the closest portion of the fault segments to the site. The portion of the San Andreas Fault system north of Slack Canyon is considered to be creeping and aseismic (Burford and Harsh, 1980). The first segment extends from Slack Canyon to Cholame. Wesnouski (1986) indicates that this fault segment is capable of generating an earthquake of Magnitude 6.6. The second segment extends from Cholame to Highway 58 and is believed to be capable of generating an earthquake of Magnitude 7.0. The third and longest segment is located between Highway 58 and Cajon Pass. This segment is described as capable of generating a Magnitude 7.7 earthquake.

*San Andreas Fault length: 345 km*

*Fault slip rate: 34.0 mm/year*

*Earthquake return interval: 206 years*

### ***“Unrecognized Seismic Systems”***

Several of the more destructive earthquakes occurring in the last several decades have resulted from fault activity on previously unknown faults. Examples include the Coalinga and North Ridge Earthquakes. The Division of Safety of Dams (DSOD) and other state agencies attempt to account for future earthquakes arising on unforeseen and unmapped faults by providing minimum earthquake which may occur near any site in California. The criteria used is a Magnitude 6.5 earthquake producing a ground motion of 0.20g arising from a fault located 8 miles from the site. These ground motion parameters were used in the liquefaction analyses described below.

### **3.3 Seismicity and Faulting**

There are a number of distant faults which are geologically active and present the potential for low to moderate intensity ground motion at the site. The foothills of Central California are bordered by active seismic zones, including faults and fault zones of the California Coast Ranges and faults and fault zones of the eastern Sierra Nevada. Figure 6, Regional Fault Map, shows locations of mapped major active and potentially active faults within 100 miles of the site

Table 1 lists the location, earthquake magnitude, site to earthquake distances, dates and the resulting site peak horizontal acceleration and the estimated Mercalli Scale of Intensity for the period 1800 to 2002. The Modified Mercalli Scale is presented as Figure 7. The table shows that the site has experienced peak horizontal accelerations up to 0.14 g (from the Owens Valley Earthquake of 1872) and 0.12g from the Coalinga Earthquake of 1983 on the Great Valley Fault, west of the Site, and site intensities up to VIII.

### **3.4 Earthquake Epicenter Distribution**

Figure 8 is a map showing historical earthquakes obtained from a search of databases containing earthquake event data. The map shows earthquakes greater than magnitude 4.0 occurring between the years 1800 and 2002. The epicenter distribution closely follows the known locations of the fault traces.

### **3.5 Upper Bounds Earthquake (UBE)**

The Upper Bound Earthquake (UBE), is defined in Section 1631A.2.6 of the 2001 California Building Code (CBC) as “the motion having a 10% probability of being exceeded in a 100-year period or maximum level of motion which may ever be expected at the building site within the known geological framework.” The UBE is typically used for hospital design. The return period for the UBE is 949 years. The UBE, formerly known as the Maximum Credible Earthquake (MCE), is the largest rational and believable magnitude earthquake that can occur within the presently known tectonic framework (CDMG Note 43). The UBE can be determined in a number of ways, including: reviewing the available current literature to determine what research has been done on a specific fault, performing an intensive field investigation (typically more comprehensive than the CDMG Note 49 guidelines for the investigation of a fault), or through the use of empirical relationships which have been developed between the length of surface fault rupture resulting from historic

earthquakes and earthquake magnitude (such as Bonilla and others, 1984). The faults in the region have been intensively studied and there is a considerable body of information available to estimate the UBE. The primary reference source in defining the UBE is “California Fault Parameters” data published in CDMG Open-File Report 96-08 (and regularly updated by the CDMG on their WWW site).

### **3.6 Design Basis Earthquake (DBE)**

The Design Basis Earthquake or DBE (also known as the Maximum Probable Earthquake, or MPE) is defined in Section 1627A of the 2001 CBC as the “ground motion that has a 10% chance of being exceeded in 50 years as determined by a site-specific hazard analysis or may be determined from a hazard map.” The return period for the DBE is 475 years. It is also understood that the magnitude shall not be lower than the maximum that has occurred within historic time (DMG Note 43).

### **3.7 Results of the Seismic Hazards Analysis**

#### ***Deterministic Seismic Hazards Analysis Ground Motion***

A Deterministic Seismic Hazards Analysis (DSHA) includes the evaluation of potentially damaging earthquake sources and deterministic selection of one or more suitable "controlling" sources and seismic events. The earthquake event magnitude for a fault is taken as the maximum value that is specific to that seismic source. Ground motion at the site is then obtained from published ground motion attenuation curves for the effects of seismic travel path using the shortest distance from the source to the site. To estimate ground motions from controlling earthquakes, a computer database of faults and attenuation relationships is used. The database includes locations and fault parameters for more than 150 faults in California and includes the most current fault data and locations. The database includes a number of attenuation relationships. The relationship selected as most appropriate for this site is from Boore et al., 1993.

Possible earthquakes from controlling faults were used for our analysis: the San Andreas and Great Valley. A review of other faults found within 100 miles of the site (see Table 2 for a list and distances) indicate a low potential for generating strong ground motion at the site due either to distance to the site or low activity of the fault.

Table 2 and Figure 9 provide estimated UBE and DBE magnitudes resulting from earthquakes occurring on active and potentially active faults and fault systems within approximately 100 miles of the site. The deterministic analysis, summarized on the table, indicates that the peak horizontal ground acceleration (PGA) for the DBE results from an earthquake on the San Andreas Fault with a PGA of 0.12g, corresponding to a site Mercalli Intensity of VII. The Great Valley Fault generates similar ground motions.

#### ***Probabilistic Seismic Hazards Analysis Ground Motion***

The Probabilistic Seismic Hazards Analysis (PSHA) differs from the DSHA in considering fault activity and the probability of occurrence from multiple fault sources. In this way, low activity faults

are considered to have a lower potential for generating ground motion at a site than higher activity faults.

The PSHA computes ground accelerations for various probability of exceedance values. A graph of Probability of Exceedance vs. Acceleration computed from the PSHA is presented as Figure 10. This shows that the PGA from the probabilistic analysis for the DBE is approximately 0.17g, and the PGA for the UBE is approximately 0.19g.

### **3.8 State of California - Probabilistic Seismic Hazards Map**

The California Division of Mines and Geology, in cooperation with the U.S. Geological Survey, performed a probabilistic seismic hazards study for the entire state. Their computed results are summarized on a map reproduced here as Figure 11. Figure 11 shows that the site area is in a region of relatively low ground motions, in the range of 0.10 to 0.20g. This is consistent with the findings of our site-specific PSHA, described in previous sections, which derived a peak ground acceleration of 0.17g for 10% in 50 year recurrence interval earthquake. The minimum ground acceleration value used by the California Division of Mines and Geology for central valley sites is 0.20g.

### **3.9 Summary of Methods to Determine Ground Motion**

Following is a summary of peak ground accelerations for the site determined by the methods in Sections 3.3, 3.6.1, 3.6.2, and 3.7.

Seismicity:	0.14g
DSHA:	0.12g
PSHA:	0.17g
CDMG PSHA Map:	0.10g to 0.20g

### **3.10 Duration of Strong Ground Motion**

The duration of strong ground motion can have a strong influence on earthquake damage and liquefaction potential. The degradation of stiffness and strength of structures and the buildup of porewater pressures in loose, saturated sands, are correlated with the number of stress reversals that occur during an earthquake. As the length of fault rupture increases, the time required for rupture increases. Consequently, the duration of strong motion increases with increasing earthquake magnitude. With increase in distance from the source, the accelerations decrease and, hence the duration. At sufficient distance from the earthquake source, the duration strong ground motion reduces to zero. An earthquake accelerogram typically contains a record of accelerations from the time the earthquake begins until the time the motion has returned to the level of background noise.

For engineering purposes, only the strong-motion portion of the accelerogram is of interest. The “bracketed” duration is defined as the time between the first and last exceedances of a threshold acceleration (usually 0.05 g). The bracketed duration for deep soil sites is usually longer than that

for shallow rock sites. Using a 0.05g threshold acceleration, Chang and Krinitszky (1977) estimated the bracketed durations. Based on the bracketed durations of strong ground motions for earthquakes arising on faults of interest, as shown on Table 3, the anticipated bracketed duration for strong ground motion is up to 10 seconds.

#### **4.0 GEOLOGIC/SEISMIC HAZARDS**

The types of geologic and seismic hazards assessed include surface ground fault rupture, liquefaction, seismically-induced settlement, slope failure, volcanic hazards, flood hazards, inundation hazards and tsunamis.

##### **4.1 Fault Rupture Hazard Zones in California**

The purpose of the Alquist-Priolo Geologic Hazards Zones Act, as summarized in CDMG Special Publication 42 (SP 42), is to "prohibit the location of most structures for human occupancy across the traces of active faults and to mitigate thereby the hazard of fault-rupture."

As indicated by SP 42, "the State Geologist is required to delineate "earthquake fault zones" (EFZs) along known active faults in California. Cities and counties affected by the zones must regulate certain development 'projects' within the zones. They must withhold development permits for sites within the zones until geologic investigations demonstrate that the sites are not threatened by surface displacement from future faulting. SP 42 also provides definitions of certain terms which are important to the evaluation of seismic hazards. These include the definitions for a fault and a fault trace, as follows:

*Active Fault:* One which has had surface displacement within Holocene time (about the last 11,000 years), hence constituting a potential hazard to structures located across it.

*Potentially Active Fault:* Initially, faults were defined as *potentially active*, and were zoned, if they showed evidence of surface displacement during Quaternary time (last 1.6 million years). The term "recently active" was not defined, as it was considered to be covered by the term "potentially active."...the term "potentially active" continued to be used as a descriptive term on map explanations on EFZ maps until 1988.

The site lies in the "Friant, California" 7.5 minute USGS quadrangle. There are no Fault-Rupture Hazard Zone Maps associated with this quadrangle.

##### **4.2 Liquefaction of Saturated Soils**

Liquefaction describes a condition in which a saturated, cohesionless soil loses shear strength during earthquake shocks. Ground motion from an earthquake may induce cyclic reversals of shearing strains of large amplitude. Lateral and vertical movement of the soil mass, combined with loss of bearing strength, usually result from this phenomena. Historically, liquefaction of soils has caused severe damage to structures, berms, levees, and roads. Seed and Idriss (1971) demonstrated that

liquefaction potential depends on soil type, void ratio, depth to groundwater, duration of shaking and confining pressures over the potentially liquefiable soil mass. Fine, well sorted, loose sand, shallow groundwater, severe seismic ground motion, and particularly long durations of ground shaking are conducive conditions for liquefaction.

Groundwater was not encountered during the field investigation. A review of well hydrograph data produced by the California Department of Water Resources indicates that the depth to groundwater has been greater than 50 feet, a depth beyond which liquefaction would be expected to occur.

#### **4.3 Seismically-Induced Settlement of Non-Saturated Soils**

Settlement of the ground surface with consequential differential movement of structures is a major cause of seismic damage for buildings founded on alluvial deposits. Vibration settlement of relatively dry and loose granular deposits beneath structures can be readily induced by the horizontal components of ground shaking associated with even moderate intensity earthquakes. Silver and Seed (1971) have demonstrated that settlement of dry sands due to cyclic loading is a function of 1) the relative density of the soil, 2) the magnitude of the cyclic shear stress, and 3) the number of strain cycles. Based on the soil and groundwater conditions present at the site, computer analyses based on the work of Youd (1993) were performed using the UBE. Computations were performed for several earthquake events including the UBE occurring on the San Andreas Fault. Settlement of the non-saturated soils due to earthquake ground motion was calculated to be less than one inch.

#### **4.4 Slope Stability and Potential for Slope Failure**

The site and surrounding areas are essentially flat and the potential hazard due to landslides from adjacent properties is nil.

#### **4.5 Volcanic Hazards**

Volcanism in California is typically associated with the Cascade Ranges and the eastern side of the Sierra Nevada. Although a minor threat, the closest source of potential future volcanic hazards is from the Long Valley Caldera and the Inyo-Mono Craters volcanic chain located near Mammoth Lakes, California. The area of eastern California where these potential volcanic hazards are located has a long history of geologic activity including both earthquakes and volcanic eruptions. This activity is likely to continue into the future. The Long Valley Caldera was created in a violent eruption 760,000 years ago. Clusters of smaller volcanic eruptions have occurred in the area at approximate 200,000 year intervals. Volcanoes in the Mono-Inyo Craters volcanic chain have erupted often over the past 40,000 years. The U.S. Geological Survey (USGS) notes that during the last 5,000 years, an eruption has occurred somewhere along this chain every 250 to 700 years; the most recent eruptions along the volcanic chain took place in the mid-1700s and mid-1800s at Paoha Island in Mono Lake. The next eruption in the Long Valley area will most likely happen somewhere along the Mono-Inyo volcanic chain. The probability of such an occurrence is less than 1% per year, similar to the annual chance of the Upper Bounds Earthquake occurring along the San Andreas Fault. The USGS forecasts the next eruption to be small and similar to previous eruptions along the Mono-

Inyo volcanic chain during the past 5,000 years. They conclude that "if magma reaches the surface, gases trapped within it can escape explosively, hurling volcanic ash as high as 6 miles or more into the air. Airborne volcanic ash can be carried hundreds of miles downwind. Thin accumulations of ash pose little threat to life or property; however, even a light dusting of fine volcanic ash can close roads and seriously disrupt communications and utilities for weeks or months after an eruption. Although the chance of volcanic eruption in any given year is small, future eruptions will occur in the Long Valley area. Volcanic unrest can escalate to an eruption within a time frame of a few weeks or less.

The USGS, in its publication *Potential Hazards from Future Volcanic Eruptions in California*, concludes that the most probable future potential hazard from the Mono Lake - Long Valley Area is for the development of small to moderate volume eruptions that will form flows and small to moderate volumes of ash. "Ash and gases from eruptions are carried away from the vent by prevailing winds. The location and extent of hazard zones for air-fall deposits are determined by the volume of the eruption, the height of the eruption column, and the direction and speed of prevailing winds. The majority of ash beds erupted at volcanoes lie east of their source vents. Winds in the western United States blow toward a direction that is east of a north-south line about 85 percent of the time." The Site is upwind of potential volcanic activity (based on prevailing wind direction). It is unlikely that smaller events will produce ash fallout in the area of the Site. During the violent eruption which occurred 760,000 years ago, the central portion of the San Joaquin Valley received several feet of ash.

#### **4.6 Flood and Inundation Hazards**

An evaluation of flooding at the site includes hazards from flooding during periods of heavy precipitation and flooding due to a catastrophic dam breach from upgradient surface impoundments.

##### ***Flood Hazards***

A review of the Flood Insurance Rate Maps (FIRMs) published by the Federal Emergency Management Agency (FEMA) was performed to obtain information regarding the potential for flooding at the site. According to the FIRM that encompasses the site (Community Panel Number 065029 0590 B, dated 1982, the site lies within an area designated as Flood Zone "X", denoted as areas outside of the 100 year flood.

##### ***Inundation Hazards***

Inundation Maps prepared by the U.S. Army Corps of Engineers show that the site does not lie within the limits of inundation in the event of a catastrophic breach (dam failure) from upstream dams. Significant flood waters for a catastrophic breach are defined as water greater than 3 feet deep or moving with a velocity sufficient to sweep a person off their feet (taken as faster than 3 feet/second).

#### **4.7 Tsunamis and Seiches**

A tsunami is a series of ocean waves generated in the ocean by an impulsive disturbance. This disturbance includes earthquakes, submarine or shoreline landslides, volcanic eruptions, and explosions. Tsunamis are not a consideration for this site since the site is so far inland from the ocean. Seiches are standing waves in larger bodies of water. No large body of water is near the site and the hazard is nil.

#### **4.8 County Seismic Safety Element**

Earthquake research in the past 20 years has provided a considerable body of new data, making the County Seismic Safety Element inappropriate for use at this site.

#### **5.0 2001 CBC SITE CATEGORIZATION PROCEDURE - DSA/SS STRUCTURES**

The site categorization procedure typical for schools for Division of the State Architect - Structural Safety (DSA/SS) structures is provided below.

##### **5.1 Site Geology and Soil Characteristics (CBC Section 1629A.3)**

Each site shall be assigned a soil profile type based on properly substantiated geotechnical data using the site categorization procedure set forth in Division VI, Section 1636A and Table 16A-J.

##### **5.2 Soil Profile Type (CBC Section 1629A.3.1)**

*Site Categorization Procedure:* Section 1629A.3.1 lists the various soil profile types. Section 1636.2.5 requires that sites with Soil Profile Types  $S_C$ ,  $S_D$  and  $S_E$  be classified by using either shear wave velocity or Standard Penetration Test blow count measurements within the upper 100 feet on site. For this project, Standard Penetration Test blow counts were used to establish the Soil Profile Type. Standard Penetration Blow counts were used to aid in soil classification. Soils show a slight trend toward increasing density and penetration resistance with depth. It is concluded that the most appropriate soil profile for this site would be  $S_D$ , described as a stiff soil with a shear wave velocity between 600 and 1,200 feet per second or with standard penetration test blow counts between 15 and 50 blows per foot.

##### **5.3 Site Seismic Hazard Characteristics (CBC Section 1629A.4)**

"Seismic hazard characteristics for the site shall be established based on the seismic zone and proximity of the site to active seismic sources, site soil profile characteristics and the structure's importance factor."

##### **5.4 Seismic Zone (CBC Section 1629A.4.1)**

The site lies in seismic zone 3. The seismic zone factor  $Z$  for this zone is 0.30.

##### **5.5 Seismic Zone 4 Near-Source Factor (CBC Section 1629A.4.2)**

The site does not lie near an active fault and does not lie within Seismic Zone 4; therefore, the near-source factor and seismic source type do not apply.

### **5.6 Seismic Response Coefficients (CBC Section 1629A.4.3)**

Based on soil profile type and seismic zone, the Seismic coefficient,  $C_a$  (from Table 16A-Q) is 0.36 and the seismic coefficient  $C_v$  (from Table 16A-R) is 0.54.

### **6.0 LIMITATIONS**

The evaluation of geologic/seismic hazards submitted in this report is based upon the data obtained from a review of geologic and seismic literature for the site area and the geotechnical investigation performed for the site. This report is issued with the understanding that it is the responsibility of the site owner, or his representative, to ensure that the information and findings contained herein are brought to the attention of the design consultants for the project and incorporated into the plans, where applicable.

The findings and recommendations presented in this report are valid as to the present and for the proposed construction. If site conditions change due to natural processes or human intervention on the site or adjacent to the site, or changes occur in the nature or design of the project, or if substantial time lapse between the date of this report and the start of work at the site, the findings contained in our report will not be considered valid unless the changes are reviewed by BSK and the findings of the report are modified or verified in writing.

BSK has prepared this report for the exclusive use of the site owner and project design consultants. The report has been prepared in accordance with generally accepted engineering geology practices within Fresno County. No other warranties, either express or implied, are made as to the professional advice provided under the terms of our agreement and included in this report.

BSK Associates

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Table 1 Historic Earthquakes Within 100 Miles of Site  
\*Ground Motion Greater Than 0.05g, Sorted by Peak Ground Acceleration  
New Fire Station No. 21  
Fresno County, California

**File Code	Latitude North	Longitude West	Date	Quake Magnitude	Site Acceleration (g)	Site Intensity (MM)	Approximate Site to Earthquake Distance	
							(mi)	(km)
DMG	36.700	118.100	3/26/1872	7.8	0.14	VIII	93	149
T-A	36.750	119.750	8/16/1864	4.3	0.12	VII	10	16
BRK	36.220	120.290	5/2/1983	6.7	0.12	VII	55	89
MGI	37.000	120.070	9/12/1928	4.6	0.09	VII	19	30
PAS	37.556	118.791	5/25/1980	6.5	0.09	VII	70	113
T-A	37.000	119.500	7/14/1894	4.3	0.09	VII	16	26
PAS	37.464	118.823	5/27/1980	6.3	0.08	VII	65	104
DMG	37.500	118.500	4/11/1872	6.6	0.08	VII	81	130
PAS	37.608	118.821	5/25/1980	6.4	0.08	VII	71	115
BRK	36.220	120.400	7/22/1983	6.0	0.08	VII	59	94
DMG	35.750	120.250	3/10/1922	6.5	0.08	VII	84	134
DMG	36.900	118.200	3/26/1872	6.5	0.08	VII	86	138
PAS	36.151	120.049	8/4/1985	5.8	0.08	VII	54	86
PAS	37.470	118.597	11/23/1984	6.2	0.07	VI	75	121
DMG	36.400	121.000	4/12/1885	6.2	0.07	VI	77	124
DMG	37.500	118.750	9/18/1927	6.0	0.07	VI	70	112
PAS	36.286	120.413	10/25/1982	5.6	0.07	VI	55	89
BRK	36.220	120.290	5/2/1983	5.6	0.07	VI	55	89
DMG	37.567	118.733	9/14/1941	6.0	0.07	VI	73	118
PAS	37.486	118.783	5/25/1980	5.8	0.06	VI	67	109
PAS	37.622	118.881	9/30/1981	5.8	0.06	VI	70	112
DMG	37.000	118.200	4/ 3/1872	6.1	0.06	VI	86	139
DMG	37.200	118.700	9/30/1889	5.6	0.06	VI	62	100
DMG	35.800	120.330	6/8/1934	6.0	0.06	VI	82	132
BRK	36.220	120.260	9/9/1983	5.4	0.06	VI	54	87
DMG	37.000	121.500	6/20/1897	6.2	0.06	VI	96	155
DMG	37.567	118.733	9/14/1941	5.8	0.06	VI	73	118
PAS	37.514	118.683	10/4/1978	5.8	0.06	VI	73	118
PAS	37.656	118.929	1/7/1983	5.7	0.06	VI	70	112
DMG	36.700	118.300	8/17/1896	5.9	0.06	VI	82	132
DMG	36.602	119.375	9/15/1973	4.4	0.06	VI	29	47
PAS	37.664	119.008	1/7/1983	5.6	0.06	VI	67	108
PDG	37.529	118.817	5/15/1999	5.6	0.06	VI	68	109
DMG	37.453	118.604	12/3/1938	5.7	0.06	VI	74	120
BRK	36.260	120.400	7/9/1983	5.3	0.06	VI	56	91
PAS	37.542	118.444	7/21/1986	5.9	0.06	VI	85	137
PAS	37.473	118.372	7/31/1986	5.9	0.06	VI	86	139
BRK	36.460	120.340	8/3/1975	4.9	0.05	VI	44	71
BRK	36.240	120.290	5/9/1983	5.2	0.05	VI	54	87
PAS	37.583	118.450	7/20/1986	5.9	0.05	VI	86	139
DMG	36.000	120.500	2/ 2/1881	5.6	0.05	VI	74	119
DMG	36.900	121.200	3/ 6/1882	5.7	0.05	VI	80	128

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Table 1 Historic Earthquakes Within 100 Miles of Site  
\*Ground Motion Greater Than 0.05g, Sorted by Peak Ground Acceleration

New Fire Station No. 21  
Fresno County, California

**File Code	Latitude North	Longitude West	Date	Quake Magnitude	Site Acceleration (g)	Site Intensity (MM)	Approximate Site to Earthquake Distance	
							(mi)	(km)
PAS	37.554	118.897	08/01/80	5.4	0.05	VI	66	106
PAS	37.449	118.653	11/26/84	5.5	0.05	VI	72	116
DMG	37.400	121.400	4/10/1881	5.9	0.05	VI	97	156
DMG	36.000	120.500	3/3/1901	5.5	0.05	VI	74	119
DMG	37.567	118.733	9/14/1941	5.5	0.05	VI	73	118
UNR	37.373	119.956	8/10/1975	4.4	0.05	VI	35	56
PAS	37.537	118.713	5/25/1980	5.5	0.05	VI	73	117
DMG	36.583	120.333	11/30/1963	4.5	0.05	VI	38	62
UNR	37.516	118.837	6/18/1980	5.3	0.05	VI	66	107
PAS	36.182	120.268	2/14/1987	5.1	0.05	VI	57	91
GSB	38.047	119.157	10/24/1990	5.7	0.05	VI	86	139
DMG	37.500	121.300	7/15/1866	5.8	0.05	VI	95	152
T-A	36.170	119.320	7/25/1868	5.0	0.05	VI	56	89
DMG	37.567	118.733	12/31/1941	5.4	0.05	VI	73	118
DMG	35.950	120.500	6/28/1966	5.5	0.05	VI	77	124
USG	37.498	118.838	6/6/1980	5.3	0.05	VI	66	106
UNR	37.536	118.851	6/20/1980	5.3	0.05	VI	67	107
BRK	36.250	120.470	6/11/1983	5.1	0.05	VI	59	96
BRK	36.210	120.380	7/25/1983	5.1	0.05	VI	58	94
PAS	37.423	118.608	11/23/1984	5.4	0.05	VI	73	118
DMG	37.200	121.500	7/ 6/1899	5.8	0.05	VI	98	158
DMG	37.330	118.420	5/6/1910	5.5	0.05	VI	80	128
DMG	37.330	118.420	1/5/1912	5.5	0.05	VI	80	128
BRK	37.100	121.500	8/6/1979	5.8	0.05	VI	97	156
DMG	36.170	120.320	12/27/1926	5.0	0.05	VI	59	95
DMG	36.680	121.300	4/9/1961	5.6	0.05	VI	87	139
BRK	36.500	120.400	8/15/1975	4.6	0.05	VI	45	72
PAS	37.509	119.043	6/11/1980	5.0	0.05	VI	58	93
DMG	36.670	121.250	8/6/1916	5.5	0.05	VI	84	135
MGI	36.580	118.080	7/6/1917	5.7	0.05	VI	95	153
DMG	37.450	118.633	2/2/1961	5.3	0.05	VI	73	117
PAS	37.538	118.675	10/4/1978	5.3	0.05	VI	74	120
USG	37.561	118.874	8/1/1980	5.2	0.05	VI	67	108
BRK	36.200	120.400	7/22/1983	5.0	0.05	VI	60	96
GSB	36.810	121.275	1/26/1986	5.5	0.05	VI	84	135

MAXIMUM SITE ACCELERATION DURING TIME PERIOD 1800 TO 2002: 0.14g

MAXIMUM SITE INTENSITY (MM) DURING TIME PERIOD 1800 TO 2002: VIII

\*\*File Code is abbreviation of recording seismograph station name.

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Table 2 Deterministic Site Ground Motion  
New Fire Station No. 21  
Fresno County, California

Fault Name	Nearest Fault to Site Distance		Upper Bounds Event			Design Basis Earthquake		
			UBE Magnitude	Peak Site Acc (g)	Site Intensity (MM)	DBE Magnitude	Peak Site Acc (g)	Site Intensity (MM)
	(mi)	(km)						
Foothills Fault System	31	49	6.5	0.17	VIII	5.2	0.08	VII
San Andreas 1857 Rupture	76	122	7.8	0.14	VIII	7.5	0.12	VII
San Andreas 1906	97	155	7.9	0.12	VII	7.4	0.09	VII
Great Valley 11	47	75	6.4	0.11	VII	5.6	0.08	VII
Owens Valley	82	132	7.6	0.11	VII	5.7	0.04	VI
Great Valley 13	51	81	6.5	0.11	VII	5.6	0.07	VI
Great Valley 9	55	88	6.6	0.11	VII	5.6	0.07	VI
Great Valley 12	47	76	6.3	0.11	VII	5.4	0.07	VI
Round Valley	67	108	6.8	0.11	VII	5.6	0.06	VI
Great Valley 10	52	84	6.4	0.11	VII	5.5	0.07	VI
Great Valley 14	56	91	6.4	0.10	VII	5.5	0.06	VI
Hilton Creek	69	111	6.7	0.10	VII	5.9	0.07	VI
Independence	79	128	6.9	0.10	VII	4.8	0.03	V
Hartley Springs	66	106	6.6	0.10	VII	5.1	0.04	VI
Mohawk - Honey Lake Zone	83	133	7.3	0.10	VII	5.9	0.05	VI
Ortogonalita	64	103	6.9	0.10	VII	5.6	0.05	VI
Great Valley 8	69	111	6.6	0.09	VII	5.7	0.06	VI
Rinconada	94	151	7.3	0.09	VII	5.8	0.04	V
Mono Lake	80	129	6.6	0.08	VII	5.9	0.06	VI
White Mountains	86	139	7.1	0.08	VII	5.7	0.04	V
Great Valley 7	86	139	6.7	0.08	VII	5.7	0.05	VI
Fish Slough	81	131	6.6	0.08	VII	4.7	0.03	V
Birch Creek	76	122	6.4	0.08	VII	5.1	0.04	V
San Juan	88	142	7.0	0.08	VII	5.6	0.04	V
San Andreas Cholame	84	135	6.9	0.08	VII	6.9	0.08	VII
Deep Springs	96	155	6.6	0.07	VII	5.3	0.04	V
Hunter Mtn. - Saline Valle	100	160	7.0	0.07	VI	6.1	0.04	VI
San Andreas Creeping	74	118	6.5	0.07	VI	6.5	0.07	VI
Sargent	93	150	6.8	0.07	VI	6.1	0.05	VI
Robinson Creek	93	150	6.4	0.07	VI	5.0	0.03	V
Zayante - Vergeles	94	152	6.8	0.07	VI	4.5	0.02	IV
Quien Sabe	81	130	6.4	0.06	VI	5.3	0.03	V
Calaveras So. of Calaveras	81	130	6.2	0.06	VI	6.2	0.06	VI

THE Foothills Fault System IS CLOSEST TO THE SITE. IT IS 31 MILES AWAY

LARGEST UPPER BOUNDS EARTHQUAKE SITE ACCELERATION: 0.17 g  
LARGEST MAXIMUM-PROBABLE SITE ACCELERATION: 0.08 g

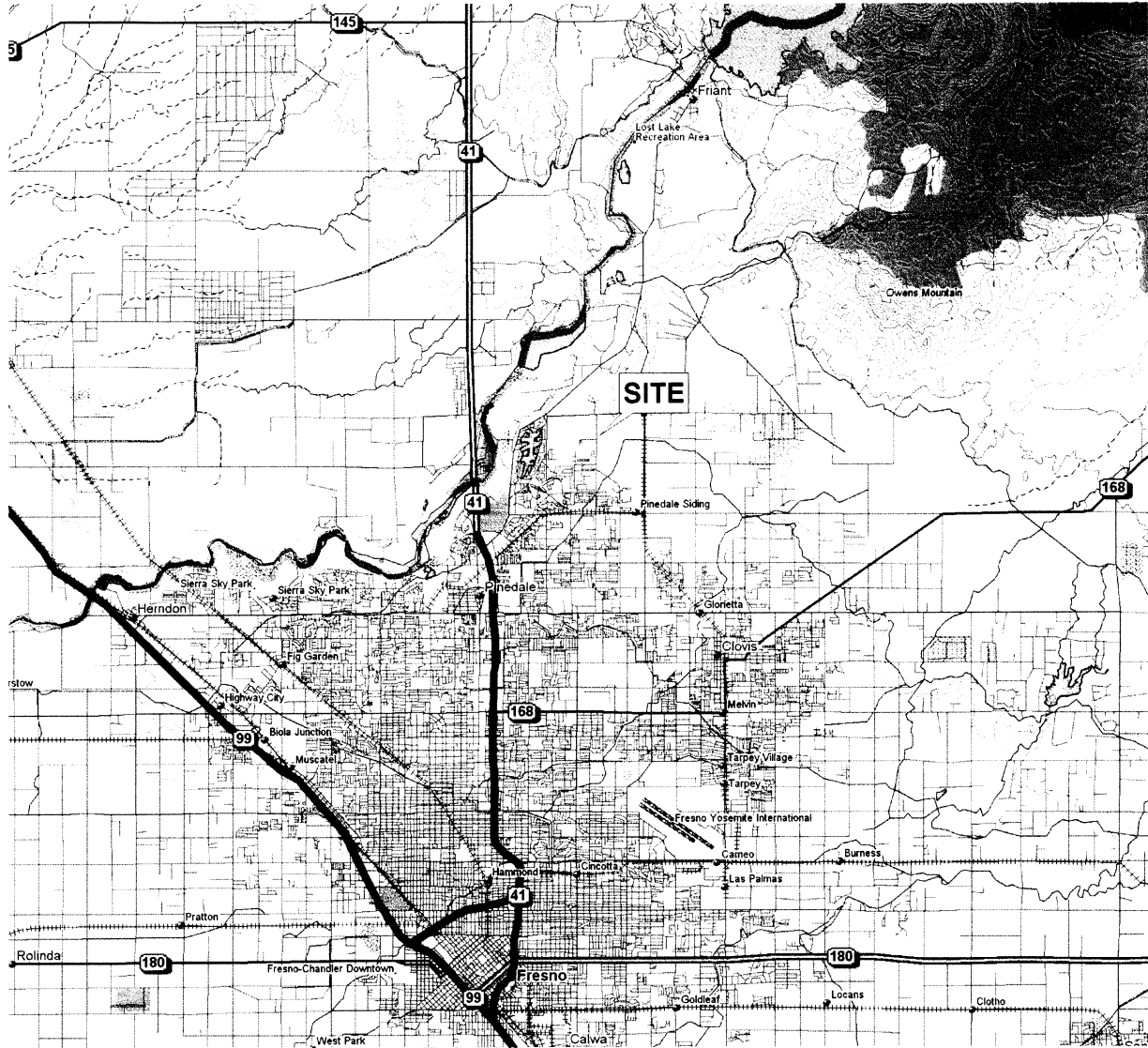
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Table 3 Bracketed Earthquake Duration  
New Fire Station No. 21  
Fresno County, California

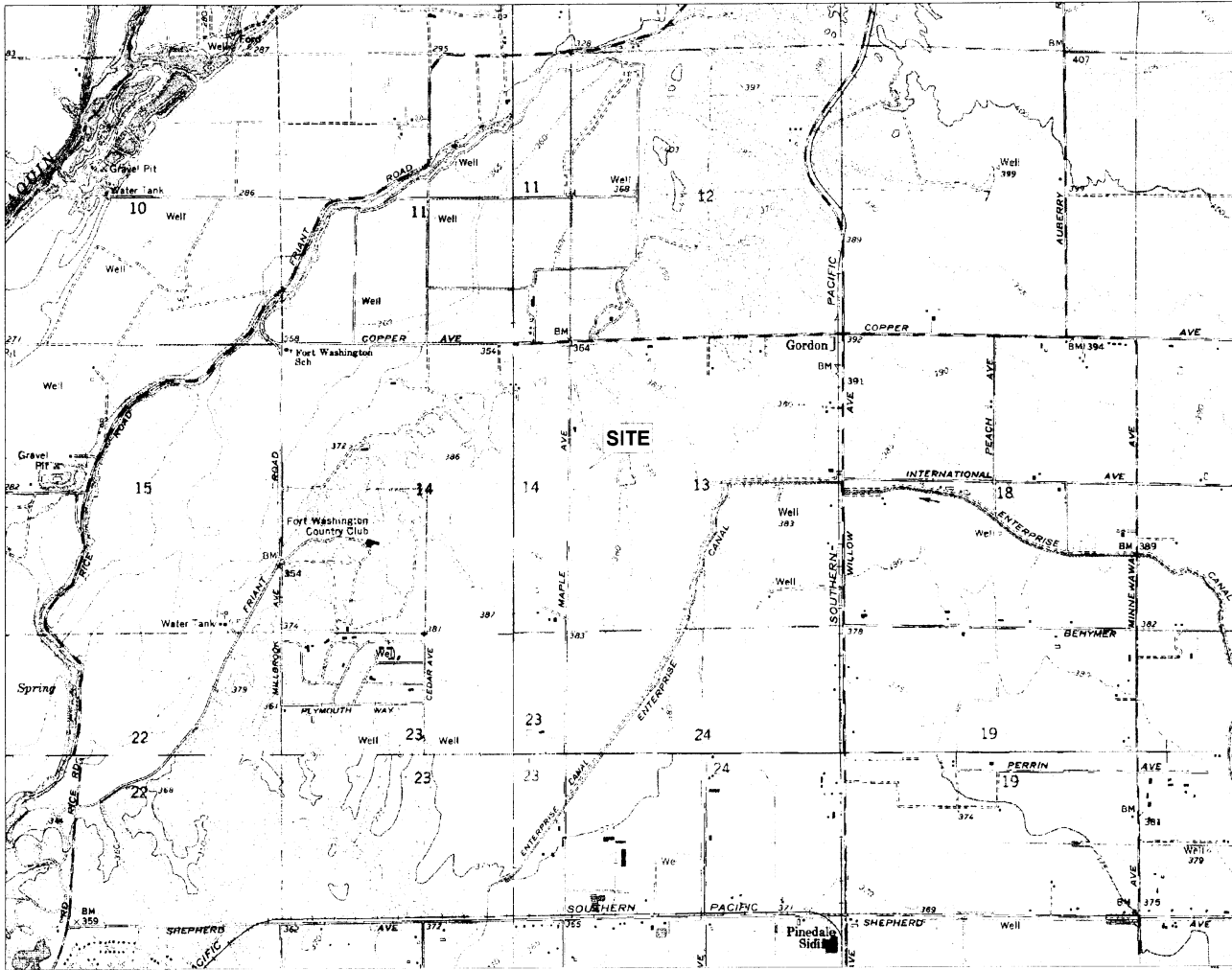
Fault Name	Approximate Fault to Site Distance		Upper Bounds Earthquake		Maximum Probable Earthquake	
			UBE Magnitude	*Bracketed Earthquake Duration (seconds)	DBE Magnitude	*Bracketed Earthquake Duration (seconds)
	(mi.)	(km.)				
Foothills Fault System	31	49	6.5	10	5.2	< 5
San Andreas 1857 Rupture	76	122	7.8	7	7.5	< 5
San Andreas 1906	97	155	7.9	< 5	7.4	< 5
Great Valley 11	47	75	6.4	6	5.6	< 5
Owens Valley	82	132	7.6	< 5	5.7	< 5
Great Valley 13	51	81	6.5	8	5.6	< 5
Great Valley 9	55	88	6.6	< 5	5.6	< 5
Great Valley 12	47	76	6.3	< 5	5.4	< 5
Round Valley	67	108	6.8	< 5	5.6	< 5
Great Valley 10	52	84	6.4	6	5.5	< 5
Great Valley 14	56	91	6.4	< 5	5.5	< 5
Hilton Creek	69	111	6.7	< 5	5.9	< 5
Independence	79	128	6.9	< 5	4.8	< 5
Hartley Springs	66	106	6.6	< 5	5.1	< 5
Mohawk - Honey Lake Zone	83	133	7.3	< 5	5.9	< 5
Ortogonalita	64	103	6.9	< 5	5.6	< 5
Great Valley 8	69	111	6.6	< 5	5.7	< 5
Rinconada	94	151	7.3	< 5	5.8	< 5
Mono Lake	80	129	6.6	< 5	5.9	< 5
White Mountains	86	139	7.1	< 5	5.7	< 5
Great Valley 7	86	139	6.7	< 5	5.7	< 5
Fish Slough	81	131	6.6	< 5	4.7	< 5
Birch Creek	76	122	6.4	< 5	5.1	< 5
San Juan	88	142	7	< 5	5.6	< 5
San Andreas Cholame	84	135	6.9	< 5	6.9	< 5
Deep Springs	96	155	6.6	< 5	5.3	< 5
Hunter Mtn. - Saline Valle	100	160	7	< 5	6.1	< 5
San Andreas Creeping	74	118	6.5	< 5	6.5	< 5
Sargent	93	150	6.8	< 5	6.1	< 5
Robinson Creek	93	150	6.4	< 5	5.0	< 5
Zayante - Vergeles	94	152	6.8	< 5	4.5	< 5
Quien Sabe	81	130	6.4	< 5	5.3	< 5
Calaveras So.of Calaveras	81	130	6.2	< 5	6.2	< 5

Note: Bracketed Earthquake Duration is defined as ground motion exceeding a threshold of 0.05 g  
Reference: Chang and Krinitzsky, 1977

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**VICINITY MAP**  
**New Fire Station No. 21**  
**Fresno County, California**



**TOPOGRAPHIC MAP**  
**New Fire Station No. 21**  
**Fresno County, California**

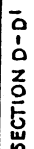


REFERENCE: U.S. Geological Survey Prepared in Cooperation  
With California of Water Resources

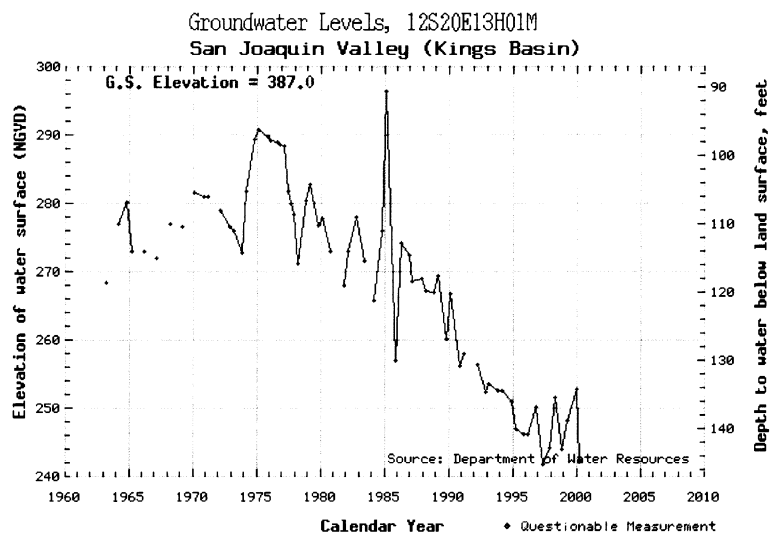
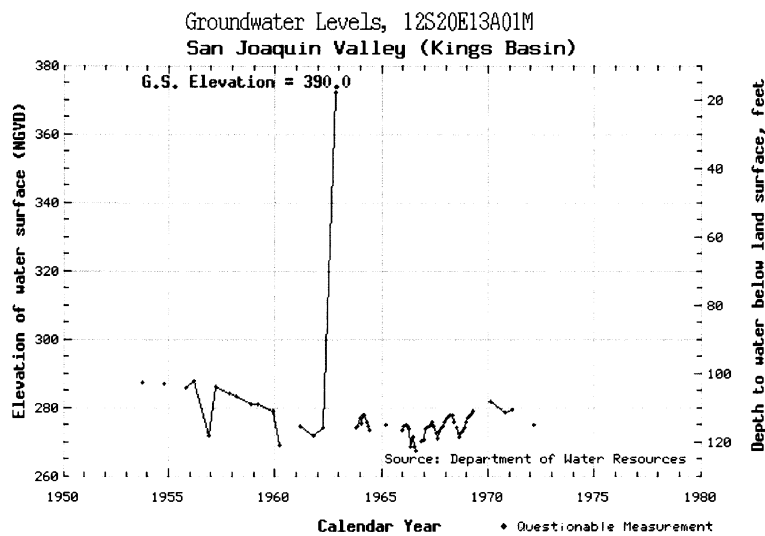
GEOLOGIC MAP OF THE FRESNO AREA, SAN JOAQUIN VALLEY, CALIFORNIA

# REGIONAL GEOLOGIC MAP

**Geologic and Seismic Hazards Assessment  
New Fire Station No. 21  
NEC of International & Maple Avenues  
Fresno, California**

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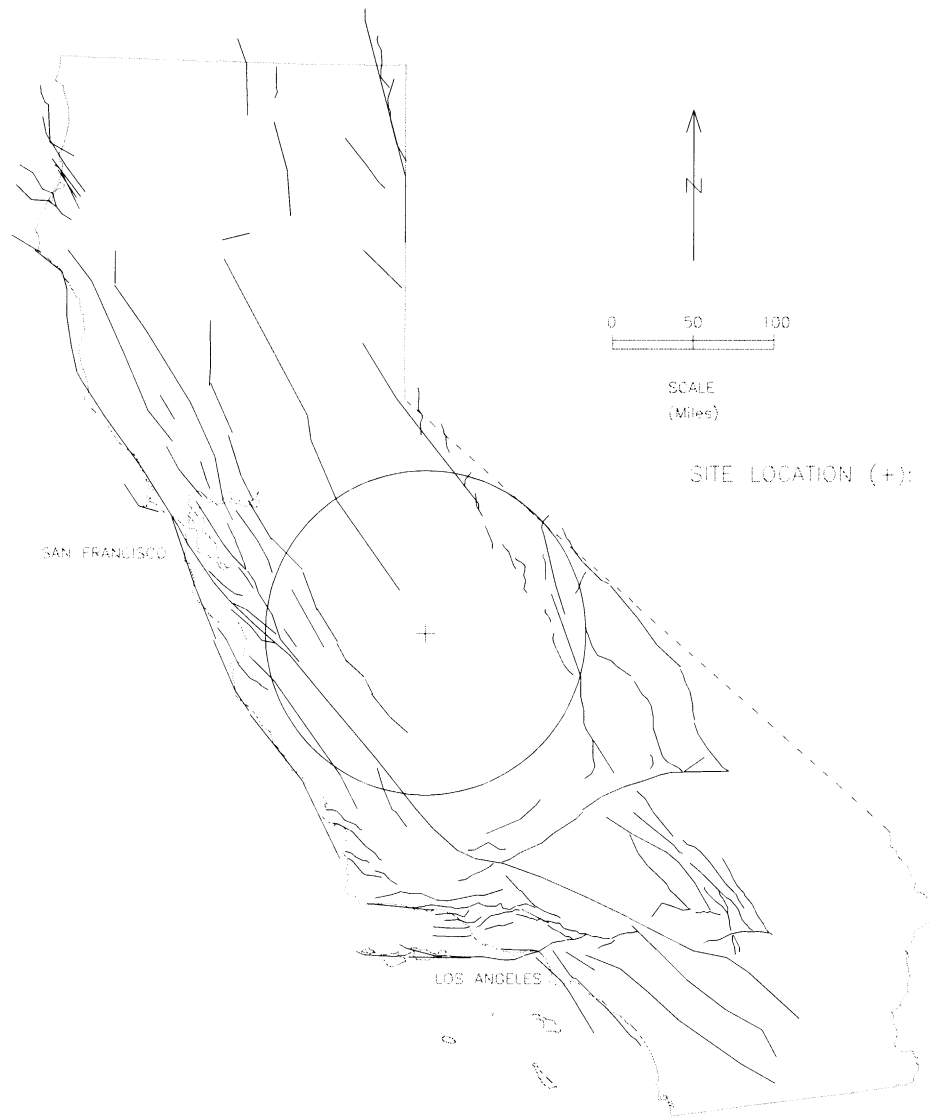
**Geologic and Seismic Hazards Assessment  
New Fire Station No. 21  
NEC of International & Maple Avenues  
Fresno, California**



## WATER TABLE HYDROGRAPHS

New Fire Station No. 21  
Fresno County, California

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**REGIONAL FAULT MAP**  
**New Fire Station No. 21**  
**Fresno County, California**

# Modified Mercalli Scale

Figure 7

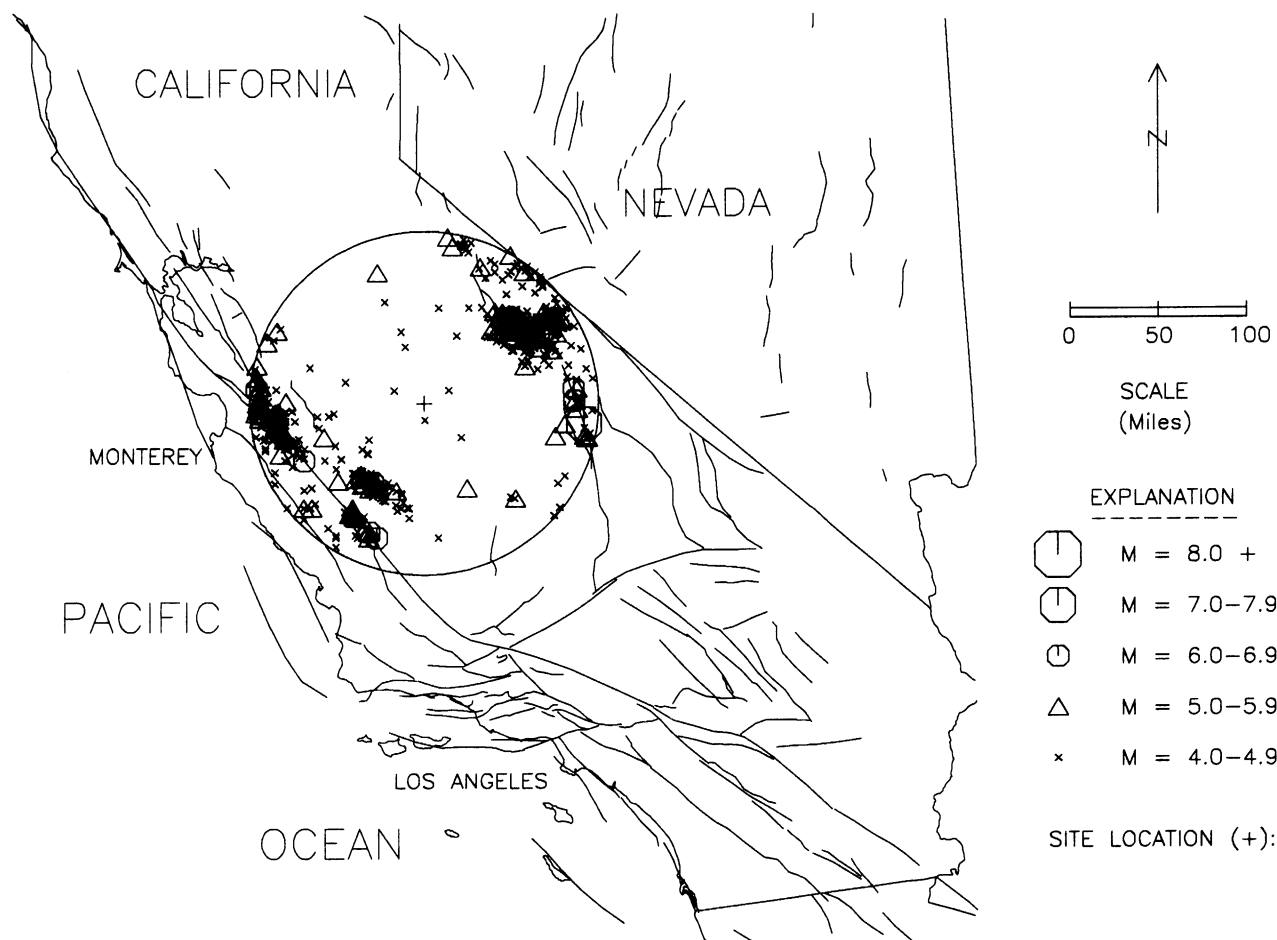
Earthquake Magnitude	MMI Intensity	<sup>1</sup> Effects	<sup>2</sup> Perceived Shaking	<sup>2</sup> Potential Damage	<sup>2</sup> Peak Vel (cm/s)	<sup>2</sup> Peak Acc. (%g)
3	I	Not felt. Marginal and long-period effects of large earthquake.	Not felt	None	<0.1	<0.17
	II	Felt by persons at rest, on upper floors, or favorably placed.	Weak	None	0.1 to	0.17 to
	III	Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.	Light	None	1.1	1.4
4	IV	Hanging objects swing. Vibration like passing of heavy trucks or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV wooden walls and frames creak.	Moderate	None	1.1 - 3.4	1.4 - 3.9
	V	Felt outdoors, direction estimated. Sleepers wakened, liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters & pictures move. Pendulum clocks stop, start, change rate.				
5	VI	Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D cracked. Small bells ring. Trees & bushes shaken (visibly or heard to rustle).	Strong	Light		
	VII	Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof lines. Fall of plaster, loose bricks, stones, tiles, cornices [also unbraced parapets and architectural ornaments-CFR]. Some cracks in masonry C. Waves on ponds, water turbine with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.	Very Strong	Moderate	16 - 31	18 - 34
6	VIII	Steering of motor cars affected. Damage to masonry C; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.	Severe	Moderate to Heavy	31 - 60	34 - 65
	IX	General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged [general damage to foundations]. Frame structures, if not bolted, shifted off foundations. Frames racked. Serious damage to reservoirs. Underground pipes broken, conspicuous cracks in ground. In alluviated areas sand and mud ejected, earthquake fountains, sand craters.	Violent	Heavy	60 - 116	65 - 124
7	X	Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly	Extreme	Very Heavy	>116	>124
	XI	Rails bent greatly. Underground pipelines completely out of service.	Extreme	Very Heavy	>116	>124
8	XII	Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air	Extreme	Very Heavy	>116	>124

Notes: <sup>1</sup> Taken from "Modified Mercalli Scale (After Hunt, 1984)"

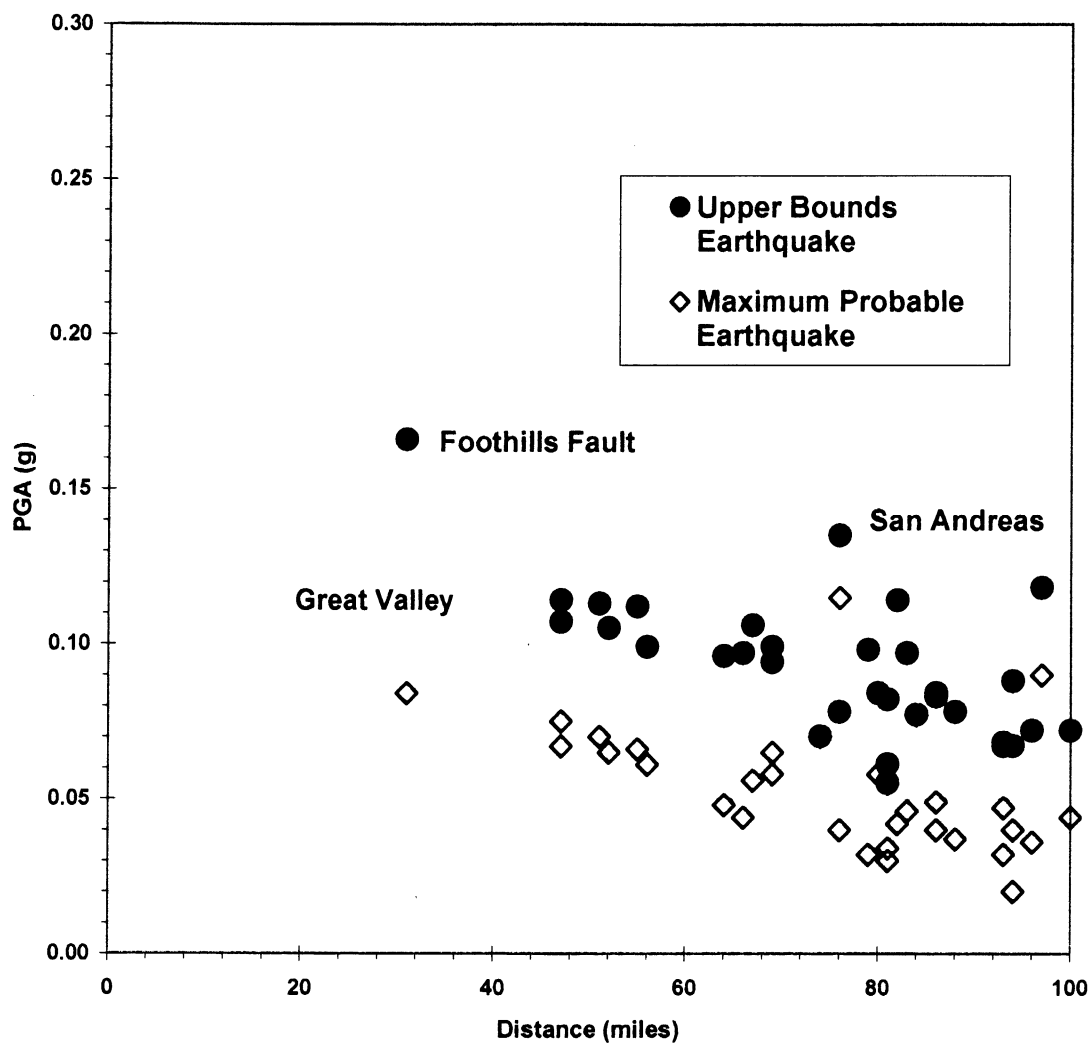
<sup>2</sup> Values taken from EERI Earthquake Spectra, Vol 15, No. 3, August 1999, pp 557-564

Masonry A, B, C, D. To avoid ambiguity of language, the quality of masonry, brick or otherwise, is specified by the following lettering (which has no connection with the conventional Class A, B, C construction).

- Masonry A: Good workmanship, mortar, and design; reinforced, specially laterally, and bound together by using steel, concrete, etc; designed to resist lateral forces.
- Masonry B: Good workmanship and mortar, but not designed to resist lateral forces.
- Masonry C: Ordinary workmanship and mortar, no extreme weaknesses such as non-tied in corners, but masonry is neither reinforced nor designed against horizontal forces.
- Masonry D: Weak materials, such as adobe; poor mortar, low standards of workmanship.

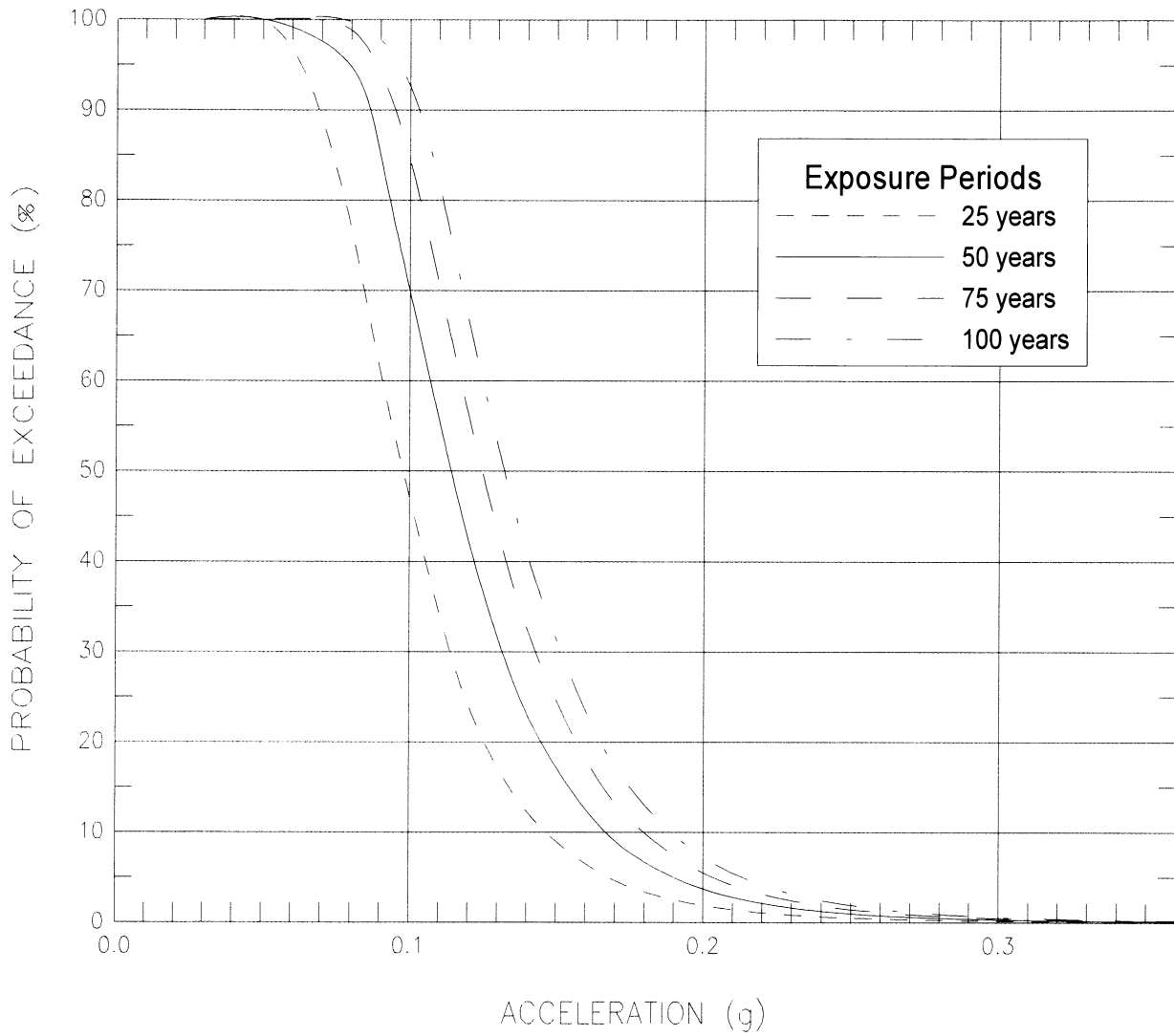


**HISTORIC EARTHQUAKES 1800 TO 2002**  
New Fire Station No. 21  
Fresno County, California

**FAULT DISTANCE VS SITE GROUND MOTION**

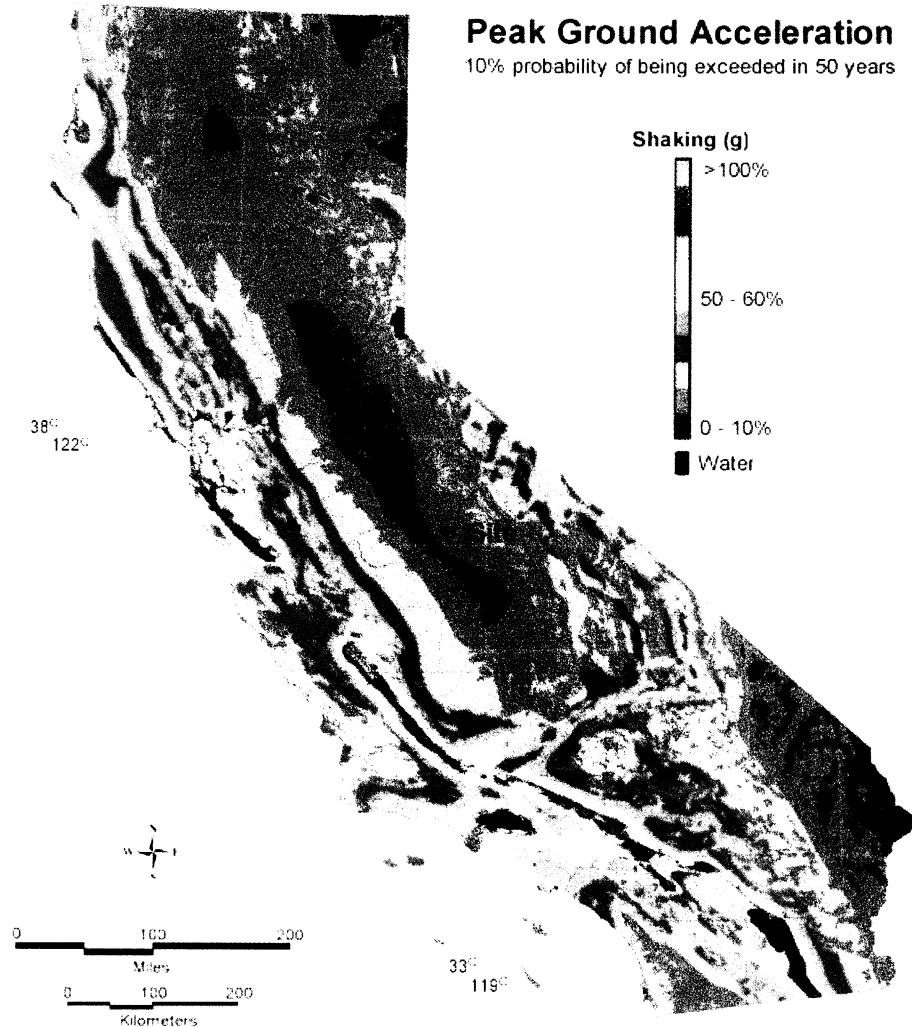
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**PROBABILITY OF EXCEEDANCE VS ACCELERATION**

**New Fire Station No. 21  
Fresno County, California**



**CALIFORNIA PROBABILISTIC SEISMIC HAZARD MAP**

**New Fire Station No. 21  
Fresno County, California**